

## Can I measure the weather? – Building a weather station (information for teachers)

### 1 Information on the subject

**Weather** is the term used in meteorology to designate the physical state of the atmosphere at a specific time at a specific location. The weather is distinguished by the **meteorological elements** and the way they interact. The meteorological elements are the measurable elements of weather that are interlinked by relationships and physical laws. Changes in these elements geographically and over time are an expression of the weather. Meteorological elements are temperature, air pressure, humidity, air motion (wind), cloudiness, precipitation, and visibility. Measurement of these meteorological elements at a certain location in combination with visual observations is known as **weather observation**.

The following experiments for building a weather station have been selected in accordance with the meteorological elements mentioned above:

- Measurement device 1: Thermometer for measuring air temperature
- Measurement device 2: Barometer for measuring air pressure
- Measurement device 3: Weather vane for observing wind force and wind direction
- Measurement device 4: Rain gauge for measuring precipitation
- Measurement device 5: Observation of clouds and visibility

### 2 Information about classroom work

The objectives of this weather observation exercise are first the seeing and measuring of weather phenomena, and second the introduction to the scientific method of taking precise and regular measurements and recording them.

Students are given the necessary information about weather processes in the information sheet for students entitled Air and weather (basics). It includes the basic information they need.

A suitable approach for implementation in the classroom is having the students work in expert groups. They are responsible for building and setting up their measurement device, carrying out daily measurements and observations, and documenting them. Depending on the grade level at which the weather observations are to be carried out, it might be possible, for example, to do without building a barometer.

It would be a good idea to schedule time for a daily weather report as well as the time for the daily measurements and documentation of readings. Each group can delegate one student to present each day's result, for example: "Today, March 20, 2012, at 9:26 a.m. it was 17 degrees."

#### 2.1 Measurement device 1: Thermometer for measuring air temperature

Students can build their measurement device with the aid of the explanations. It is important here to be aware of the need to choose a suitable measuring location (sun/shade).

#### 2.2 Measurement device 2: Building a barometer to measure air pressure

Students can build a barometer following the instructions for setting up the experiment. They can then observe how the balloon skin presses inward when the air pressure is high (high pressure) and the tip of the pointer (skewer) pushes upward. When the air pressure drops again (low pressure), the balloon skin rises and the pointer moves downward.

### 2.3 Measurement device 3: Making a weather vane for observing wind force and wind direction

Students can make a weather vane with a compass rose by following the instructions and referring to the figure. They may need assistance with setting it up and orienting it to the north with the compass.

### 2.4 Measurement device 4: Building a rain gauge for measuring precipitation

Students can build a rain gauge following the instructions for setting up the experiment. In Germany, precipitation is given in l/m<sup>2</sup> in weather reports.

### 2.5 Measurement 5: Observation of clouds and visibility

Some students may find this measurement task boring. For this reason, orientation points that are measured accurately first, for example, using the Internet, are used as a means of determining the visibility. Here again, this develops students' ability to measure precisely and to make preparations.

This measurement can therefore also be given optionally as an additional assignment for students who are good at working with length measurements and distances.

### 2.6 Material list per expert group

- 1 thermometer
- 1 cardboard strip (5 cm wide, 20 cm long)
- 1 canning jar without lid (about 1 l)
- 1 balloon
- 1 large kitchen rubber band
- 1 skewer
- 2 wooden sticks (e.g., 2 round wooden dowels, Ø 1.5 cm, length: 1 m)
- 1 piece of cloth
- 1 compass rose, or cardboard if compass rose is to be self-made
- 1 plastic bottle with flat base
- 1 compass, if required
- 1 transparency marker
- 1 ruler
- Tape
- Glue
- Scissors
- Pens
- Map of the school location and the surrounding region within a 50 km radius (e.g., Google Earth)
- Optional: Symbol charts for cloudiness and visibility

## 3 Safety information

Students should handle scissors and skewers with care.